Chemical Reactions – 2022 IGCSE

1. June/2022/Paper_11/No.12

Which row identifies a chemical change and a physical change?

	chemical change	physical change
A	boiling ethanol	burning ethanol
B	burning ethanol	evaporating ethanol
C	dissolving ethanol in water	burning ethanol
D	evaporating ethanol	dissolving ethanol in water

2. June/2022/Paper_11/No.15

Water is added to anhydrous copper(II) sulfate.

What happens during the reaction?

A The copper(II) sulfate turns blue and the solution formed gets colder.

B The copper(II) sulfate turns blue and the solution formed gets hotter.

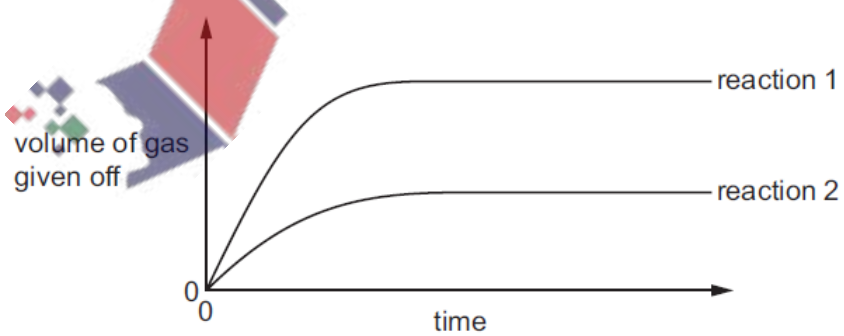
C The copper(II) sulfate turns white and the solution formed gets colder.

D The copper(II) sulfate turns white and the solution formed gets hotter.

3. June/2022/Paper_11/No.16

Excess magnesium ribbon is reacted with a fixed volume of hydrochloric acid and the volume of gas given off over time is measured.

The results of two different experiments are shown.



Which statement explains the differences between the results of the two experiments?

A Reaction 1 uses a catalyst.

B The acid used is twice as concentrated in reaction 1.

C The magnesium ribbon is in smaller pieces in reaction 2.

D The temperature is higher in reaction 2.

4. June/2022/Paper_12/No.12

Which row identifies a chemical change and a physical change?

	chemical change	physical change
A	boiling ethanol	burning ethanol
B	burning ethanol	evaporating ethanol
C	dissolving ethanol in water	burning ethanol
D	evaporating ethanol	dissolving ethanol in water

5. June/2022/Paper_12/No.13

Which statement about rate of reaction is correct?

A Catalysts increase the time for the reaction to be completed.

B Decreasing particle size increases the rate of reaction.

C Decreasing temperature increases the rate of reaction.

D Rate of reaction decreases as the concentration increases.

6. June/2022/Paper_13/No.12

Which row identifies a chemical change and a physical change?

	chemical change	physical change
A	boiling ethanol	burning ethanol
B	burning ethanol	evaporating ethanol
C	dissolving ethanol in water	burning ethanol
D	evaporating ethanol	dissolving ethanol in water

7. June/2022/Paper_13/No.14

Metal M reacts with steam and produces gas G.

Which row identifies gas G and the type of reaction when metal M reacts with steam?

	gas G	type of reaction
A	hydrogen	redox
B	hydrogen	neutralisation
C	oxygen	redox
D	oxygen	neutralisation

8. June/2022/Paper_21/No.12

Which row identifies a chemical change and a physical change?

	chemical change	physical change
A	boiling ethanol	burning ethanol
B	burning ethanol	evaporating ethanol
C	dissolving ethanol in water	burning ethanol
D	evaporating ethanol	dissolving ethanol in water

9. June/2022/Paper_21/No.13

The equation for the reaction between gaseous hydrogen and gaseous iodine to form gaseous hydrogen iodide is shown.

$$H_2(g) + I_2(g) \rightarrow 2HI(g)$$

The reaction is exothermic.

Which statement explains why the reaction is exothermic?

A Energy is released when H–H and I–I bonds are broken.

B The bond energies of the reactants are larger than the bond energies of the products.

C The products are at a higher energy level than the reactants.

D More energy is released when two HI bonds are formed than is used when the H–H and I–I bonds are broken.

10. June/2022/Paper_21/No.14

Acidified aqueous silver nitrate is added to a test-tube containing aqueous chloride ions.

The test-tube is then left in direct sunlight.

Which row describes the observations and explains what happens to the reaction mixture?

	observation on adding aqueous silver nitrate	observation after leaving in sunlight	explanation
A	yellow precipitate	precipitate dissolves	silver chloride forms
B	yellow precipitate	precipitate turns grey	silver ions are reduced
C	white precipitate	precipitate dissolves	silver chloride forms
D	white precipitate	precipitate turns grey	silver ions are reduced

11. June/2022/Paper_21/No.15

Water is added to anhydrous copper(II) sulfate.

What happens during the reaction?

A The copper(II) sulfate turns blue and the solution formed gets colder.

B The copper(II) sulfate turns blue and the solution formed gets hotter.

C The copper(II) sulfate turns white and the solution formed gets colder.

D The copper(II) sulfate turns white and the solution formed gets hotter.

12. June/2022/Paper_21/No.16

Aqueous iron(III) chloride, $FeCl_3$, reacts with aqueous potassium iodide, KI.

$$v FeCl_3 + w KI \rightarrow x FeCl_2 + y KCl + I_2$$

Which statements are correct?

1 In the balanced equation, *v*, *w*, *x* and *y* have the same value.

2 Potassium iodide is an oxidising agent.

3 A dark brown solution is produced in the reaction.

A 1 and 2 **B** 1 and 3 **C** 2 only **D** 2 and 3

13. June/2022/Paper_22/No.12

Which row identifies a chemical change and a physical change?

	chemical change	physical change
A	boiling ethanol	burning ethanol
B	burning ethanol	evaporating ethanol
C	dissolving ethanol in water	burning ethanol
D	evaporating ethanol	dissolving ethanol in water

14. June/2022/Paper_22/No.13

Which statements explain why increasing the concentration of a reactant increases the rate of reaction?

1 It increases the collision rate of particles.

2 It lowers the activation energy.

3 A greater proportion of the colliding molecules have the required activation energy.

4 There are more particles per unit volume.

A 1 and 3 **B** 1 and 4 **C** 2 and 3 **D** 2 and 4

15. June/2022/Paper_22/No.14

When the colourless gas N_2O_4 is heated, it forms the brown gas NO_2.

When the reaction mixture is cooled, the brown colour fades and turns back to colourless.

Which type of reaction is described by these observations?

A decomposition

B displacement

C reduction

D reversible

16. June/2022/Paper_22/No.15

Water is added to anhydrous copper(II) sulfate.

What happens during the reaction?

A The copper(II) sulfate turns blue and the solution formed gets colder.

B The copper(II) sulfate turns blue and the solution formed gets hotter.

C The copper(II) sulfate turns white and the solution formed gets colder.

D The copper(II) sulfate turns white and the solution formed gets hotter.

17. June/2022/Paper_23/No.12

Which row identifies a chemical change and a physical change?

	chemical change	physical change
A	boiling ethanol	burning ethanol
B	burning ethanol	evaporating ethanol
C	dissolving ethanol in water	burning ethanol
D	evaporating ethanol	dissolving ethanol in water

18. June/2022/Paper_23/No.14

Which statement explains why increasing the concentration of a reactant increases the rate of the reaction?

A A greater proportion of the particles have the activation energy so there are more successful collisions.

B Particles have more energy so there are more frequent collisions.

C There are more particles in the same volume so there are more frequent collisions.

D The particles move more quickly so there are more frequent collisions.

19. June/2022/Paper_23/No.15

Water is added to anhydrous copper(II) sulfate.

What happens during the reaction?

A The copper(II) sulfate turns blue and the solution formed gets colder.

B The copper(II) sulfate turns blue and the solution formed gets hotter.

C The copper(II) sulfate turns white and the solution formed gets colder.

D The copper(II) sulfate turns white and the solution formed gets hotter.

20. June/2022/Paper_23/No.33

In the Contact process, sulfur dioxide is converted into sulfur trioxide.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

What is the effect of lowering the pressure on the rate of formation and percentage yield of sulfur trioxide at equilibrium?

	rate of formation	percentage yield
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

21. June/2022/Paper_31/No.7(a _b)

This question is about zinc and compounds of zinc.

(a) Zinc is a metal.

Give **three** physical properties of metals.

1 .....

2 .....

3 .....

[3]

(b) Zinc reacts with phosphorus to form zinc phosphide, Zn_3P_2.

Complete the equation for this reaction.

.....Zn + ...P → Zn_3P_2 [2]

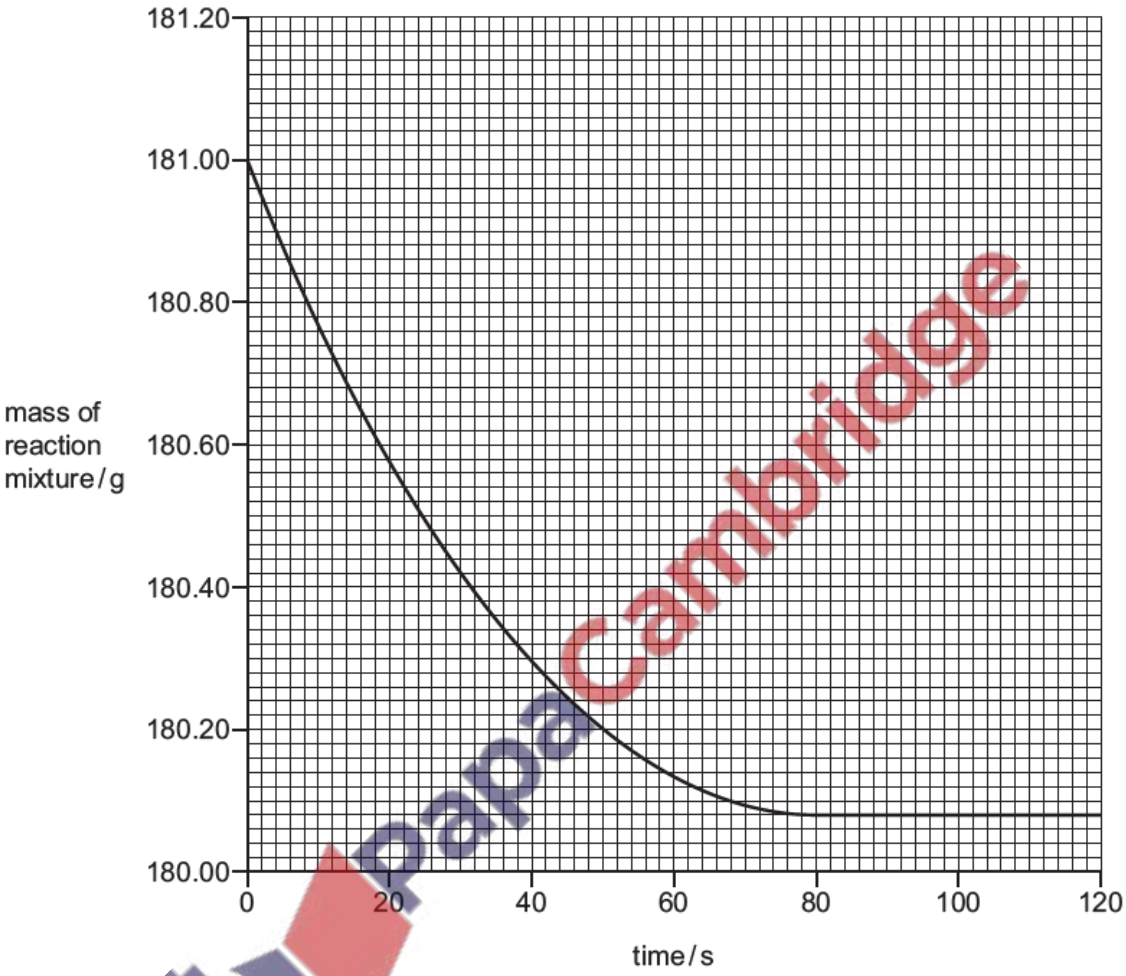
22. June/2022/Paper_31/No.8(a _c)

A student investigates the reaction of large pieces of copper(II) carbonate with dilute hydrochloric acid. The hydrochloric acid is in excess.

$$CuCO_3 + 2HCl \rightarrow CuCl_2 + CO_2 + H_2O$$

The rate of reaction is found by measuring the mass of the reaction mixture as time increases.

The results are shown on the graph.



(a) Deduce the mass of the reaction mixture at 30 s.

mass = ... g [1]

(b) The experiment is repeated using smaller pieces of copper(II) carbonate.

All other conditions stay the same.

Draw a line **on the grid** to show how the mass of the reaction mixture changes as time increases. [2]

(c) Describe the effect each of the following has on the rate of reaction of copper(II) carbonate with dilute hydrochloric acid.

All other conditions stay the same.

- The reaction is carried out in the presence of a catalyst.

.....

- The reaction is carried out using a lower concentration of hydrochloric acid.

.....

[2]

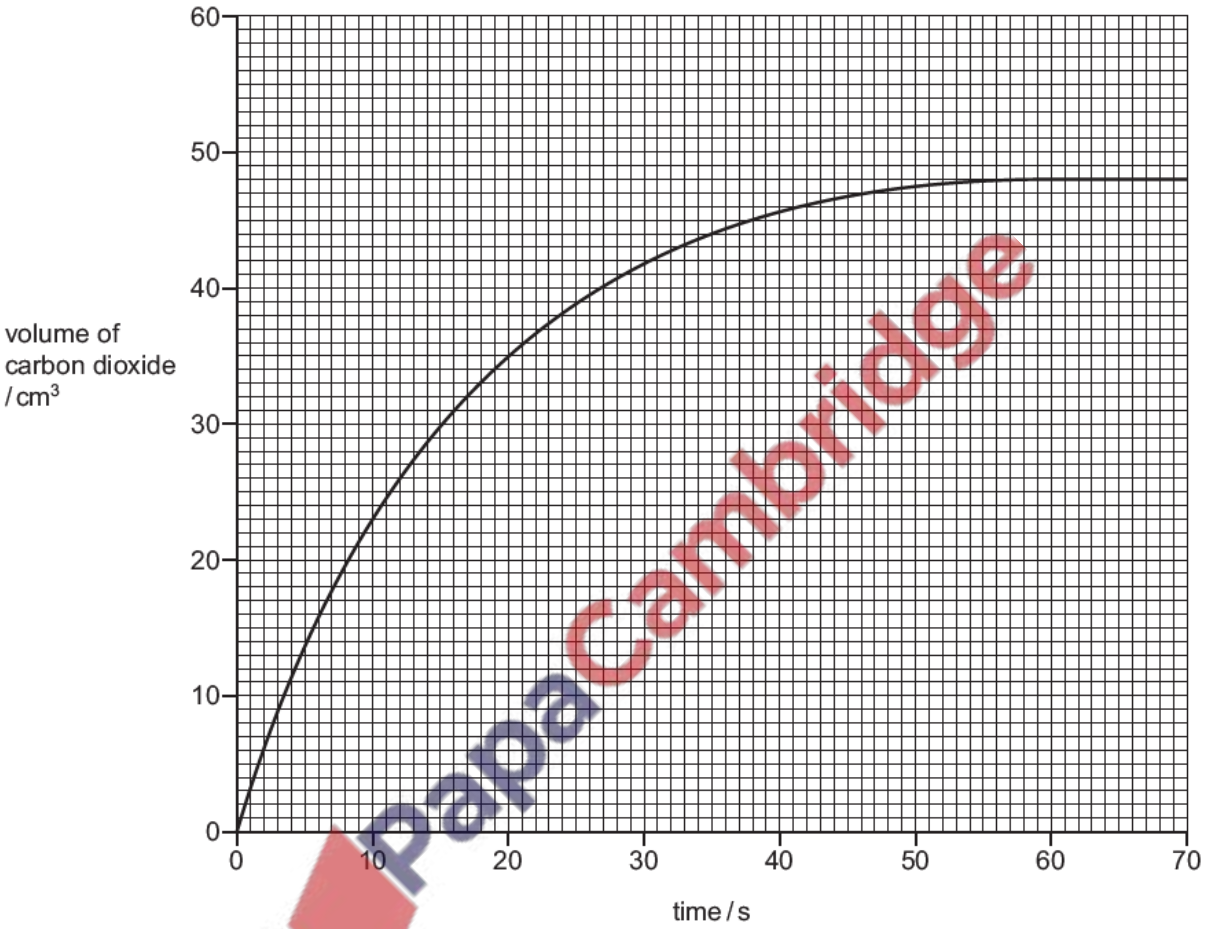
23. June/2022/Paper_32/No.8

A student investigates the reaction of small pieces of calcium carbonate with dilute hydrochloric acid. The hydrochloric acid is in excess.

$$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$$

The rate of reaction is found by measuring the volume of carbon dioxide gas produced as time increases.

The results are shown on the graph.



(a) Deduce the volume of carbon dioxide gas at 35 s.

volume = ... cm^3 [1]

(b) The experiment is repeated at a higher temperature.

All other conditions stay the same.

Draw a line **on the grid** to show how the volume of carbon dioxide gas produced changes as time increases. [2]

(c) Describe the effect each of the following has on the rate of reaction of calcium carbonate with dilute hydrochloric acid.

All other conditions stay the same.

- The reaction is carried out using a higher concentration of hydrochloric acid.

.....

- The reaction is carried out using powdered calcium carbonate.

.....

[2]

(d) When 0.11 g of calcium carbonate is used, 25 cm^3 of carbon dioxide gas is produced.

Calculate the mass of calcium carbonate needed to produce 100 cm^3 of carbon dioxide gas.

mass of calcium carbonate = ... g [1]

(e) State **one** use of calcium carbonate.

..... [1]

[Total: 7]

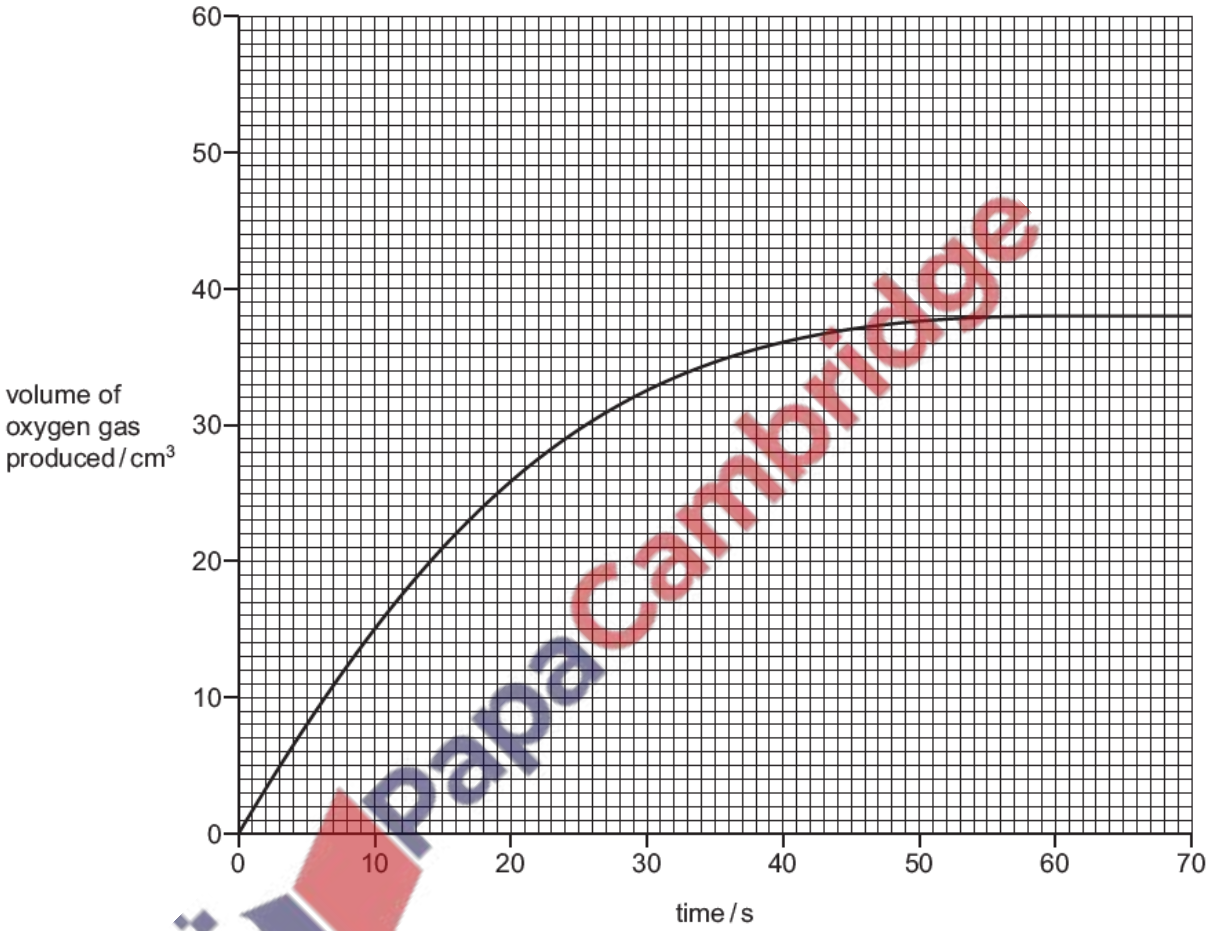
24. June/2022/Paper_33/No.8

A student investigates the rate of decomposition of aqueous hydrogen peroxide using 0.2 g of a catalyst.

$$2H_2O_2 \rightarrow 2H_2O + O_2$$

The rate of reaction is found by measuring the volume of oxygen gas produced as time increases.

The results are shown on the graph.



(a) Deduce the time taken to collect 35 cm^3 of oxygen gas.

time = ... s [1]

(b) The experiment is repeated using 0.2 g of smaller pieces of the catalyst.

All other conditions stay the same.

Draw a line **on the grid** to show how the volume of oxygen gas produced changes as time increases. [2]

(c) Describe the effect each of the following has on the rate of decomposition of hydrogen peroxide.

All other conditions stay the same.

- The reaction is carried out at a higher temperature.

.....

- The reaction is carried out using a lower concentration of hydrogen peroxide.

.....

[2]

(d) Hydrogen peroxide reduces sodium chlorate(I), NaC*l*O, to sodium chloride.

$$H_2O_2 + NaClO \rightarrow NaCl + H_2O + O_2$$

Describe how this equation shows that sodium chlorate(I) has been reduced.

..... [1]

[Total: 6]

25. June/2022/Paper_41/No.1

A list of substances is shown.

aluminium oxide	**carbon dioxide**	**chlorine**	**diamond**	**ethanol**
glucose	**iron(III) oxide**	**limestone**	**nitrogen**	**oxygen**

Answer the questions using the list of substances.

Each substance may be used once, more than once or not at all.

State which of the substances:

(a) is a reactant in photosynthesis

..... [1]

(b) is the main constituent of bauxite

..... [1]

(c) are **two** products of fermentation

..... and ..... [2]

(d) is used as a fuel

..... [1]

(e) is a gas used to convert iron into steel

..... [1]

(f) is a greenhouse gas

..... [1]

(g) is a gas that is approximately 78% of clean, dry air

..... [1]

(h) is a form of carbon.

..... [1]

[Total: 9]

26. June/2022/Paper_41/No.5(a _d)

Ethanoic acid is manufactured by the reaction of methanol with carbon monoxide.

An equilibrium mixture is produced.

$$CH_3OH(g) + CO(g) \rightleftharpoons CH_3COOH(g)$$

(a) State **two** characteristics of an equilibrium.

1 .....

2 .....

[2]

(b) The purpose of the industrial process is to produce a high yield of ethanoic acid at a high rate of reaction.

The manufacture is carried out at a temperature of 300 °C.

The forward reaction is exothermic.

Use this information to state why the manufacture is **not** carried out at temperatures:

- **below** 300 °C

.....

- **above** 300 °C.

.....

[2]

(c) Complete the table using only the words *increases*, *decreases* or *no change*.

	effect on the rate of the forward reaction	effect on the equilibrium yield of $CH_3COOH(g)$
adding a catalyst		no change
decreasing the pressure		

[3]

(d) Suggest which of the following metals is a suitable catalyst for the reaction. Give a reason for your answer.

aluminium **calcium** **cobalt** **magnesium** **potassium**

suitable catalyst .....

reason .....

[2]

27. June/2022/Paper_42/No.2

Calcium hydroxide, $Ca(OH)_2$, is slightly soluble in water.

(a) Calcium hydroxide can be made by the reaction of calcium with water.

(i) Write the chemical equation for this reaction.

..... [2]

(ii) Name another substance that reacts with water to form calcium hydroxide.

..... [1]

(b) When calcium hydroxide dissolves in water, it dissociates into ions and forms a weakly alkaline solution.

(i) Suggest the pH of aqueous calcium hydroxide.

..... [1]

(ii) Give the formula of the ion responsible for making the solution alkaline.

..... [1]

(c) Limewater is a saturated solution of calcium hydroxide, $Ca(OH)_2(aq)$.

(i) Name the gas limewater is used to test for.

..... [1]

(ii) Suggest what is meant by the term *saturated solution*.

.....

..... [2]

(iii) Describe how you would make a sample of limewater starting with solid calcium hydroxide.

.....

.....

..... [2]

(iv) Describe how you would test for the presence of calcium ions in a sample of limewater.

test .....

observations .....

.....

[3]

(d) A 25.0 cm^3 sample of limewater is placed in a conical flask. The concentration of $Ca(OH)_2$ in the limewater is determined by titration with dilute hydrochloric acid, HCl.

(i) Name the item of apparatus used to measure the volume of acid in this titration.

..... [1]

(ii) State the type of reaction which takes place.

..... [1]

(iii) As well as limewater and dilute hydrochloric acid, state what other type of substance must be added to the conical flask.

..... [1]

(iv) The equation for the reaction is shown.

$$Ca(OH)_2 + 2HCl \rightarrow CaCl_2 + 2H_2O$$

20.0 cm^3 of 0.0500 mol/dm^3 HCl reacts with the 25.0 cm^3 of $Ca(OH)_2$.

Determine the concentration of $Ca(OH)_2$ in g/dm^3. Use the following steps.

- Calculate the number of moles in 20.0 cm^3 of 0.0500 mol/dm^3 HCl.

..... mol

- Determine the number of moles of $Ca(OH)_2$ in 25.0 cm^3 of the limewater.

..... mol

- Calculate the concentration of $Ca(OH)_2$ in mol/dm^3.

..... mol/dm^3

- Determine the concentration of $Ca(OH)_2$ in g/dm^3.

..... g/dm^3
[5]

[Total: 21]

28. June/2022/Paper_43/No.1

A list of substances is shown.

aluminium oxide	**carbon dioxide**	**carbon monoxide**	**chlorine**	**copper**
glucose	**iron(III) oxide**	**limestone**	**nitrogen**	**oxygen**

Answer the questions using the substances in the list.

Each substance may be used once, more than once or not at all.

State which substance is:

(a) a product of respiration

..... [1]

(b) the main constituent of hematite

..... [1]

(c) an element which has a sulfate that is used to test for water

..... [1]

(d) a colourless toxic gas

..... [1]

(e) a reactant in fermentation

..... [1]

(f) a reducing agent in the extraction of iron

..... [1]

(g) a conductor of electricity when solid

..... [1]

(h) a gas that is approximately 21% of clean, dry air.

..... [1]

[Total: 8]

29. June/2022/Paper_43/No.4(a, **b)**

Ethanol is made industrially by the reaction of ethene with steam. The reaction occurs at a temperature of 300 °C and a pressure of 60 atmospheres.

$$C_2H_4(g) + H_2O(g) \rightleftharpoons C_2H_5OH(g)$$

A catalyst is used in this reaction.

The forward reaction is exothermic.

(a) State what is meant by the term *catalyst*.

.....

..... [2]

(b) Complete the table using only the words *increases*, *decreases* or *no change*.

	effect on the rate of the forward reaction	effect on the equilibrium yield of $C_2H_5OH(g)$
increasing the temperature		
decreasing the pressure		

[4]

30. March/2022/Paper_22/No.18

The reaction used to manufacture ammonia from nitrogen and hydrogen is reversible.

An equilibrium is established between ammonia, nitrogen and hydrogen.

Which statement describes the equilibrium?

A Both the forward reaction and the backward reaction have the same rate.

B The rate of the backward reaction is greater than the rate of the forward reaction.

C The rate of the forward reaction is greater than the rate of the backward reaction.

D The forward and backward reactions have both stopped.

31. March/2022/Paper_22/No.19

How does increasing the concentration affect the reacting particles in a chemical reaction?

	increases the collision rate	increases the proportion of particles with the activation energy
A	✓	✗
B	✓	✓
C	✗	✗
D	✗	✓

32. March/2022/Paper_32/No.4(c)

(c) The rate of reaction of zinc powder with dilute sulfuric acid is found by measuring the increase in volume of hydrogen gas produced as time increases.

Describe the effect, if any, of each of the following on the rate of this reaction.

- The reaction is carried out with large pieces of zinc instead of zinc powder.

All other conditions stay the same.

.....

- The reaction is carried out using a catalyst.

All other conditions stay the same.

.....

- The reaction is carried out with dilute sulfuric acid of a lower concentration.

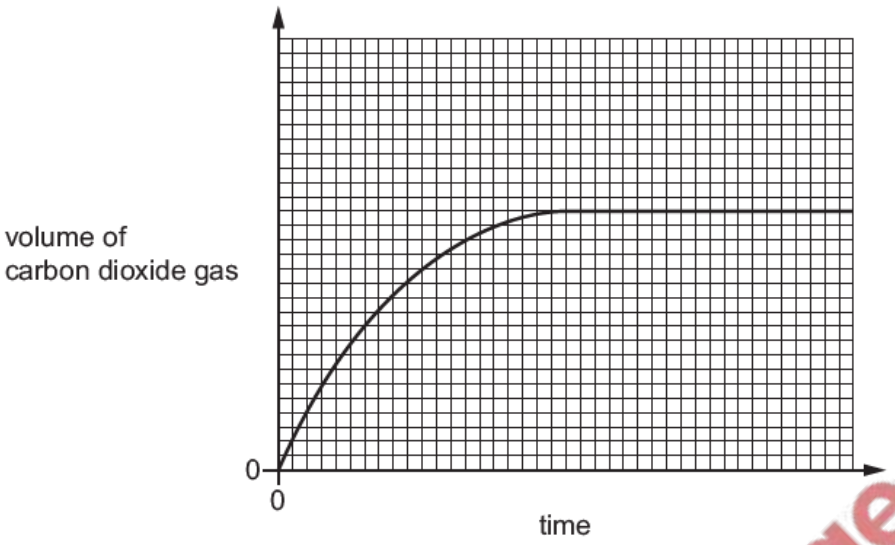
All other conditions stay the same.

.....

[3]

33. March/2022/Paper_43/No.2(d)

(d) The graph shows how the volume of carbon dioxide gas changes with time.



(i) Describe how the graph shows that the rate of this reaction decreases as time increases.

.....

..... [1]

(ii) Explain, in terms of particles, why the rate of this reaction decreases as time increases.

.....

..... [2]

(iii) The student repeats the experiment using powdered $MgCO_3$ instead of large pieces.

All other conditions stay the same.

On the grid, draw the line expected when powdered $MgCO_3$ is used instead of large pieces. [2]